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MEMORANDUM

Date: January 14, 1998

To: Stein Buer
Mark Cowin

From: Gary Bardini

Subject: **CALFED Phase II Storage and Conveyance Refinement Process Summary**

The CALFED Bay-Delta Program has been developing and analyzing a series of alternatives through an open public process over the last two years. In Phase I, completed in the Fall of 1996, CALFED developed a short list of alternatives. Phase II of the program included a detailed technical analysis of each alternative. This analysis will lead to identification of a preferred Alternative and will be documented in a Programmatic Environmental Impact Report/Statement (EIR/EIS). Phase III of the program will develop project-level EIR/EIS's for implementation of the preferred alternative.

For Phase II, significant technical work was produced in the storage and conveyance refinement process. These activities include:

- ♦ evaluation of general operating parameters through hydrologic and Delta simulation modeling
- ♦ evaluation of capacities and dimensions of storage and conveyance components
- ♦ technical studies of both environmental and engineering nature
- ♦ development of preliminary cost estimates for the storage and conveyance components and common programs
- ♦ preliminary evaluations to determine the feasibility of sites for locating the various action items

The foundational work for Phase II began in January 1996. However, the majority of the technical effort began in September 1996. This technical effort focused on 1) hydrologic and Delta simulation modeling, 2) preliminary cost and feasibility studies, and 3) technical studies.

Hydrologic and Delta Simulation Modeling

One of the most fundamental issues of the storage and conveyance refinement process was devising fair and reasonable operation concepts and rules for the CALFED Alternatives. During 1996, CALFED solicited input on proposed operating concepts over a six month period and incorporated them in the range of evaluation. These concepts were defined in a "Storage and Conveyance Alternative Component Refinement Process" document dated September 5, 1996. This document was the catalyst for the Phase II storage and conveyance hydrologic and hydrodynamic modeling activities, which consisted of 1) refining operating concepts and rules, 2) spreadsheet post-processing operation modeling, 3) system operation modeling, and 4) delta hydrodynamic modeling.

Operation Parameters and Plan for Alternatives: Any water resource planning evaluation must be initiated by making some assumption about concepts for diverting, releasing, and allocating water in the system. For a complete evaluation of CALFED alternatives, was necessary to fully explore the interaction of storage and conveyance components as measured by the full range of CALFED goals. Input from the CALFED agencies and stakeholder community as to the appropriate range of operating concepts was integrated into an operation plan for modeling the Alternatives. These initial concepts were defined in a "Storage and Conveyance Alternative Component Refinement Process," document dated September 5, 1996.

A compilation of suggestions from stakeholders for system operating parameters along with a description of the Alternatives for the Programmatic EIR/EIS were presented at the CALFED Storage and Conveyance Workshop on March 20, 1997. This information is documented in the "Status Reports on Technical Studies for the Storage and Conveyance Refinement Process," dated March 20, 1997. Updates on initial spreadsheet post-processing modeling, system operation modeling, and Delta modeling were also included in the status report.

Based on the initial hydrologic and Delta hydrodynamic studies, more refined operating rules were prepared for the Alternatives and described in the "CALFED Bay-Delta Program System Operation Modeling Plan" (Operation Modeling Plan), dated on July 23, 1997. Again, input from the CALFED agencies and stakeholder community was integrated into this plan. The Operation Modeling Plan describes the assumptions for existing conditions, no action and the program alternatives and DWRSIM program modifications necessary to evaluate the alternative components. The operation assumptions in the Operation Modeling Plan were presented at Storage and Conveyance Workshop on June 25, 1997 by CALFED staff.

Spreadsheet Post-Processing Model: Initial evaluations of potential new storage were analyzed using the CALFED Post-Processing Operation Model. This tool was used to do relatively quick evaluations to help guide the overall storage and conveyance study effort. The evaluations included sensitivity analyses of operation parameters and storage capacities for various storage facilities dedicated to environmental water supply benefits and agricultural and urban water supply benefits. The model provided a suitable method for analyzing the general effects of various storage operation rules and goals, identifying critical external constraints, and providing initial refinement to the ranges of storage and conveyance capacities to be considered in more detailed system operation studies.

The initial sensitivity evaluation of operational parameters and storage capacities using the CALFED Post-Processing Operation Model was presented at the Storage and Conveyance Workshop on March 20, 1997 by CALFED staff. This initial information is documented in the "Status Reports on Technical Studies for the Storage and Conveyance Refinement Process" dated March 20, 1997. CALFED completed two reports summarizing the sensitivity of various operation parameters and physical capacities of potential new storage and conveyance facilities using the spreadsheet-based CALFED Post-Processing Model in the following reports:

- South of Delta off-aqueduct surface storage
- Sacramento Valley and San Joaquin Valley groundwater storage

Following the Storage and Conveyance Workshop on September 24, 1997, DWR and SWRI updated and completed the operation studies described in the operation modeling plan along with some sensitivity studies. CALFED staff held a meeting with stakeholders on October 30, 1997 to inform the stakeholder community of the preliminary results and to develop additional sensitivity criteria for system operation analysis. This information was provided in a report titled "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: A Status Report on System Modeling Using DWRSIM", dated October 30, 1997. This preliminary work represented combinations of the following alternative components using DWRSIM Version 9.06 model:

- 5,000 cfs and 15,000 cfs Isolated Facility
- Environmental Sacramento River tributary offstream surface storage
- Environmental San Joaquin offstream surface storage
- Agricultural/Urban Sacramento River tributary offstream surface storage
- South of Delta off-aqueduct surface storage
- In-Delta surface storage
- Sacramento Valley and San Joaquin Valley groundwater storage

In an effort to refine the CALFED Program Alternatives and recommend a preferred draft alternative, CALFED organized an Interagency Development Team (IDT) in mid-October. Several new operation criteria were devised by IDT to further refine CALFED Program Alternatives and were modeled by DWR and CALFED staff. For predicting the water supply consequences of the alternatives, two operation criteria were analyzed to represent a range of possible operational rules that might be necessary to protect the Delta ecosystem for each alternative. System operation studies were complete both with and without storage being for each alternative.

The preliminary results of the sensitivity studies were presented to the CALFED Policy Group in a presentation package titled "CALFED Bay-Delta Program Water Supply Opportunities: Evaluation of Refined Alternatives" on November 24, 1997. A presentation package on the initial evaluation of the alternatives prior to the IDT effort was also presented to the CALFED Policy Group. This presentation package is titled "CALFED Bay-Delta Program Water Supply Opportunities: Initial Evaluation of Alternatives".

At the Storage and Conveyance Workshop on January 22, 1998, the sensitivity studies conducted for IDT and the CALFED Policy Group were presented. The system operation studies are summarized in a report titled "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: A Status Report on System Modeling Using DWRSIM," dated January 22, 1998.

Delta Simulation Modeling: DWRSIM and the spreadsheet models can only estimate in the broadest terms effects on conditions in the Delta. Delta modeling is required to evaluate the effects of flows, stages, velocities, salinities, particle transport in the Delta due to Delta conveyance configurations and new facilities. As part of this work, Delta modeling with DWRSIM1 and later

Deltawide hydraulics and water quality of CALFED alternative 3A and 3B were completed later in a report titled "Status Reports on Technical Studies for Storage and Conveyance Refinement Process: Delta Simulation Model Studies of Alternatives 3A and 3B," dated October 2, 1997. CALFED alternatives 3A and 3B assume a 5,000 cfs isolated facility and South Delta flow control structures. Alternative 3B assumes an in-Delta storage component.

Delta conditions for the CALFED alternatives were simulated by DWRDSM1 using a 16 water year period (1975-91) under a common hydrology from DWRSIM operation study 472B. Study 472B assumed a 1995 level of development and a 2020 level of water demands under the SWRCB 1995 water Quality Control Plan with permit allowing up to 10,300 cfs pumping at Banks Pumping Plant. This 16 period represents a wide range of Delta inflows and export conditions.

Delta modeling results include: flows and velocities, circulation patterns, salinity, and water level in the south Delta. Circulation patterns are presented using average flow directions and mass tracking studies. Salinity is discussed using end of month total dissolved solids and X2 location.

The recalibration of the Delta Simulation Model 1 (Suisun Marsh Version) model by DWR Suisun Marsh Branch was completed in September 1997. A final report titled "Status Reports on Technical Studies for Storage and Conveyance Refinement Process: Recalibration of the Delta simulation Model I (Suisun Marsh Version)," dated September 4, 1997 summarizes the geometry revision base on the latest Delta and Bay bathymetry data, and the DSM1 hydrodynamics and salinity recalibration based on the later flow and salinity data.

In an effort to refine the CALFED Program alternatives, additional Delta simulations were conducted using DWR's new Delta simulation model, DWRDSM2. The Delta simulation model has river, estuary, and land modeling improves described below:

- ♦ **River** - Can simulate riverine systems, and has been extended from Sacramento to Shasta Dam. Also has been tested with high flow/stage simulations for flood modeling.
- ♦ **Estuary** - Completely flexible estuary model; stages and flows may be specified at boundary and internal points.
- ♦ **Land** - Includes effects from land-based processes, such as consumptive use and agricultural runoff.

DWRDSM2 calculates stage, flow, velocities; many mass transport processes, including salts, multiple non-conservative constituents, temperature, THM formation potential and individual particles. Delta alternatives 1A, 1C, 2B, and 3E (modified) were analyzed with DWRDSM2, using DWRSIM-produced Delta hydrologies 516, 531, 532, and 551 respectively. A summary description of the Delta alternatives configurations are:

- ♦ **Alternative 1A** - Existing Delta geometry with no changes to any Delta channels or structure

Table 1 - Hydrologic and Hydrodynamic Modeling Reports and Documents

Reports and Documents

Operation Parameters and Plan for Alternatives

- ♦ "Storage and Conveyance Alternative Component Refinement Process" document dated September 5, 1996
- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process" dated March 20, 1997 "- Compilation of suggestions for System Operating Parameters, CALFED Bay-Delta Program Modeling Section and Alternatives for Programmatic EIR/EIS Evaluation Sections.
- ♦ "CALFED Bay-Delta Program System Operation Modeling Plan" document dated July 23, 1997

Spreadsheet Post-Processing Operation Models

- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process" dated March 20, 1997 "- Post Processing Operation Model, Initial Results Draft Report.
- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process: Evaluation of Upstream Storage and South of Delta Off-Aqueduct Storage Using the CALFED Post-Processing Spreadsheet Operations Model", dated May 9, 1997.
- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process: Combined Environmental - Agricultural and Urban Water Supply Evaluation using the CALFED Post-Processing Spreadsheet Operations Model", dated May 12, 1997

System Operation Modeling

- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process" dated March 20, 1997 "- System Modeling Studies of CALFED Alternatives using DWRSIM Section.
- ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: A Status Report on System Modeling Using DWRSIM", dated September 24, 1997
- ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Preliminary Results/Evaluation of System Modeling with DWRSIM", dated September 23, 1997
- ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: A Status Report on System Modeling Using DWRSIM", dated October 30, 1997
- ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: A Status Report on System Modeling Using DWRSIM", dated January 22, 1998

Delta Hydrodynamic Modeling

- ♦ "Status Report on Technical Studies for the Storage and Conveyance Refinement Process" dated March 20, 1997 "- Delta Modeling: (a) Model Studies of CALFED Alternatives using DWRDSMI Section, (b) Recalibration of DWRDSMI, Suisun Marsh Version Section
 - ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Delta Simulation Model Studies of Alternatives 1A, 1C, 2B, 2D, 2E, 3E", dated August 4, 1997
 - ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Recalibration of the Delta Simulation Model I (Suisun Marsh Version), dated September 4, 1997
 - ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Addendum and Errata to Delta Simulation Model Studies of Alternatives 1A, 1C, 2B, 2D, 2E, 3E", dated September 24, 1997
 - ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Delta Simulation Model Studies of Alternatives 3A and 3B", dated September 24, 1997
 - ♦ "CALFED Bay-Delta Program Storage and Conveyance Refinement Process: Delta Simulation Model Studies of Alternatives 1A, 1C, 2B, 3E (modified), dated December 1, 1997"
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backgrounds in biology, civil engineering, geology, and hydrology are identifying and eliminating impracticable surface water storage locations. The criteria for eliminating a surface water storage location is 1) inadequate storage volumes, 2) conflicts with CALFED's restoration programs, 3) excessive cost, and 4) engineering constraints. Site locations with high environmental impacts are being "red flagged" as locations with higher mitigation costs.

A list of preliminary cost and feasibility reports produced during Phase II for the storage and conveyance refinement process is shown in Table 2:

Table 2 – Preliminary Cost and Feasibility Reports

Reports and Documents	
♦	"CALFED Bay-Delta Program Storage and Conveyance Component Inventories", dated March 7, 1997
♦	"CALFED Storage and Conveyance Components Refinement Process," dated October, 1997

Technical Studies

Several technical reports have been completed as part of the storage and conveyance refinement process. Reports on flood control reoperations options with storage created under the CALFED Bay-Delta Program and groundwater use with special emphasis on conjunctive use projects were completed by CALFED.

The New Year's Day Flood of 1997 was probably the largest in the 90-year northern California measured record which begins in 1906. It was notable in the sustained intensity of rainfall, the volume of floodwater and the areal extent – from the Oregon border down to the southern end of the Sierra. New flood records were set on many of the major Central Valley rivers. Immediately following the New Year's Day Flood of 1997, CALFED examined the possibility of transferring flood control space from Shasta Lake and Lake Oroville to new offstream storage being preliminarily investigated. A report titled "Status Report on Technical Studies for the Storage and Conveyance Refinement Process: CVP/SWP Flood Control Reoperation," describes the evaluation using a CVP/SWP spreadsheet model.

Groundwater provides about 40 percent of the urban and agricultural water supply in California. Appropriate and effective groundwater management is essential to the success of CALFED Bay-Delta Program. To this end, CALFED conducted an outreach on groundwater use to help identify and address stakeholder concerns about groundwater use and management with special emphasis on conjunctive use projects. A report titled "Status Report on Technical Studies for the Storage and Conveyance Refinement Process: CALFED Groundwater Outreach Program," dated November 12, 1997 describes the progress of the outreach program. The report discloses the scope of the program, definitions of groundwater terms to help facilitate discussion of groundwater issues, draft principles for CALFED conjunctive use projects, a summary of stakeholder concerns, and preliminary mitigation strategies to address those concerns.

A list of technical reports produced during Phase II for the storage and conveyance refinement process is shown in Table 3: